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Number 7-8

⑩ M. E. Bell

No. 7 - 8

⑪ 15 April 1953

⑫ 17 p. ⑭ ESN-7-8

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15 April 1953   No 7 - 8

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EXTRA-NUCLEAR INFLUENCES ON ANGULAR CORRELATIONS

It is well known that the angular correlation between successive nuclear radiations may be influenced by the surroundings in which the emitting nucleus finds itself. In particular, previous work at the E.T.H. in Zurich has shown that the anisotropy, $\mathcal{E} = \dfrac{W(\pi)-W(\pi/2)}{W(\pi/2)}$,

of the γ-γ angular correlation in the decay of In^{111} by electron capture to Cd^{111} varies between zero and -0.20, depending upon whether the source is embedded in an ionic crystalline material or in a metal of suitable thickness.

There has previously been little experimental evidence concerning the nature of the reorienting influences affecting angular correlations, although there have been suggestions that a magnetic interaction between the electronic shell and the nuclear magnetic moment could be responsible in some cases. In addition, the character of the anomalous α-γ angular correlation observed in the decay of radio-thorium suggests the possibility of an electric reorientation through the nuclear quadrupole moment. Recent work at the E.T.H. in Zurich, however, clearly demonstrates the existence of a quadrupole effect in the case of the cadmium correlation, and rules out any significant magnetic destruction of the correlation. This work has been carried out by a group consisting of H. Albers-Schönberg, F. Hänni, E. Heer, T.B. Novey, and P. Scherrer.

Magnetic Decoupling Experiment

The Swiss group has performed a magnetic de-coupling experiment which should, in principle, eliminate the effect on the angular correlation of the coupling between nuclear and electronic magnetic moments. The magnitude of the field necessary to produce decoupling can be

estimated fairly accurately from the known half-life of
the excited nuclear state by attributing the destruction
of the correlation entirely to a magnetic interaction.
A field of 20,000 gauss was found sufficient and was ap-
plied along the direction of one of the two gamma-ray
counters by means of a magnet having a hole through the
pole face to allow γ rays to reach the detector. The
anisotropy of the angular correlation observed in the mag-
netic field was calculated from the measured ratio of the
coincidence rate at 180° with full magnetic field, to the
coincidence rate at the same angle without field, by using
the experimentally determined anisotropy of the correla-
tion in zero field. Such essentially experimental deter-
minations of the anisotropy in the "decoupling" magnetic
field were carried out for a number of sources in which
the In^{111} atoms were embedded in various media and also
for sources where the indium compounds were in crystalline
form or in solution. No appreciable variation of the
anisotropy with external magnetic field was found in any
of the magnetic decoupling experiments, thus providing
strong evidence against the destruction of the Cd^{111} cor-
relation by the magnetic field of the electronic shell.

Search for an Electric Quadrupole Effect

The existence of large electric fields in crystals
having lower than cubic symmetry gives the possibility of
subjecting a nucleus to an electrically-produced torque
which acts on its quadrupole moment. In fact, Pound (Harvard)
has proposed the alignment of nuclear spins at low tempera-
tures by this technique. The Swiss group has performed
angular correlation measurements on metallic indium single
crystals (face centered tetragonal) which should have an
electric field of axial symmetry. It is to be expected
theoretically that the anisotropy of the angular correlations
in such crystals will depend on the angle between the
crystallographic c-axis and the normal to the plane in which
the correlation measurement is made. A similar effect is
predicted when the c-axis lies in the plane of the counters,
and then depends on the angle between the axis and the fixed
counter. Both of these effects have been observed at Zurich.
In each case a rapid variation of anisotropy with angle is
observed, and the ratio between maximum and minimum anisotropy
is of the order of 3:1. In addition, a theoretically pre-
dicted phase shift in the correlation which depends on the
angles mentioned above has also been observed.

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Further Experiments

The Swiss demonstration of the existence of the quadrupole interaction effect in the cadmium correlation gives the possibility of determining the quadrupole moment of the excited intermediate nuclear state involved. It is understood that further experiments in this direction are in progress at the E.T.H. In this connection it will be necessary to assume the electric field gradient in the crystal or determine it by other means.

MEASUREMENT OF THE MASS OF THE BRISTOL K-1 MESON

Dr. Kirster Kristiansson of the University of Lund, Sweden, has recently completed a careful redetermination of the mass of the Bristol K-1 meson using the photoelectric method developed at Lund by Kristiansson and Prof. von Friesen (cf. Technical Report ONRL-71-51). The particle in question was observed by the Bristol group in a 400 micron thick Ilford G-5 emulsion exposed under 30 cm of lead on the Jungfraujoch. The track begins near the surface of the emulsion and ends 4,000 microns later near the glass with a subsequent decay into one charged and one or more neutral particles. Earlier the Bristol group measured the mass by scattering and range methods and by a combination of gap counting and range observations. These methods gave (1260 ± 290) and (1385 ± 200) electron masses respectively. Dr. Kristiansson has now obtained a mass value of $(1518 \pm 70)m_e$, this being a refinement of his value of $(1550 \pm 130)m_e$ reported earlier. (Technical Report ONRL-5-52)

A detailed account of the technique of this mass measurement will be published soon in the Philosophical Magazine by Dr. Kristiansson.

Significance of the Result

The Lund result, with its high asserted precision, takes on significance in relation to the present situation concerning the masses of kappa and chi mesons. At the Copenhagen Conference, July 1952, it was felt (cf. Technical Report, ONRL-72-52) that the masses of these particles could be distinguished by scattering and gap-count methods as 1030 and 1470 electron masses respectively. At the present time, however, the Bristol group tends to set the mass of both particles at about 1150 m_e and considers them, even if actually particles of different mass, to be indistinguishable by scattering and gap-count techniques

(see Technical Report, ONRL-11-53). When the Lund result of 1518m_e is compared with present Bristol values of $\sim$1150m_e there is, of course, an immediate suggestion of a systematic difference between the results of the photoelectric and the more conventional methods of mass determination. Even if this systematic error is ascribed entirely to the photoelectric method, the method because of its inherently greater precision may still possess real value as a means of distinguishing a difference between kappa and chi mesons by measurement of the mass difference between them. The method might, for example, be applied as an empirical one, comparing kappa and chi masses with the mass of protons found in the same plates. If measurements on a number of kappa and chi particles showed two distinct groupings outside the resolution of the Lund determination, non-identity of the two particles might be considered demonstrated regardless of whether the photoelectric technique gave the absolute mass values correctly. By calibration on proton tracks, effects of different development conditions between different plates could be corrected; also recent work at Lund has shown that the fading of the latent image is less than anticipated, so that it would not be essential that the proton and meson tracks be produced at the same times.

A MAGNETOPHOTOVOLTAIC EFFECT IN GERMANIUM

Dr. Pierre Aigrain and M. Hubert Bulliard of l'Ecole Normale Superieure, Paris, have recently observed a magnetophotovoltaic effect in single crystals of germanium at room temperature, and have developed a mathematical theory which seems to be in agreement with the observations. They have suggested that the effect be called the "Kikoin" effect after the Russian who first observed it in 1934 in CuO at liquid air temperatures (Kikoin and Noskov, Phys. Z. Sowjet. 5, 586 (1934)).

The Kikoin effect is observed when a semiconductor in a magnetic field is exposed to a beam of light at right angles to the field. The effect is observed as an e.m.f. along a direction at right angles to both the illumination and the magnetic field. According to Aigrain, it may be understood intuitively by picturing the trajectories of holes and free electrons created by the light beam as being bent by the magnetic field in opposite directions and thus producing a potential gradient.

Frenkel (ibid, 8, 185 (1935)) attempted to explain the effect, but his analysis depended upon postulation of a difference in the mobility of the holes and electrons. Subsequent experiments have demonstrated that the effect can be found in specimens where the electron and hole mobilities

are substantially the same, and it was this consideration which led Aigrain and Bulliard to re-examine the problem.

In the last few months, they have derived new formulas to describe the effect and have made measurements, the results of which support these formulas. It is their conclusion that the Kikoin voltage can be described by

$$V_k = \frac{AL}{B + L}$$

where

$$A = \frac{hH}{C\left[1 + \left(\frac{\mu H}{C}\right)^2\right]} \cdot \frac{D^2 \alpha \beta}{\sigma + D(\alpha + \beta)}$$

and

$$B = \frac{N\ell}{2} \cdot \frac{\beta D \ (\sigma + \beta D) \ (\alpha + \beta)}{\sigma + D \quad (\alpha + \beta)}$$

where V_k = Kikoin voltage
 L = light intensity in photons/cm^2/sec
 H = magnetic field
 h = length of specimen
 D = diffusion coefficient
 α = absorption coefficient for the wave length used
 β is defined by the equation $D\beta^2$ = 1
 τ = carrier lifetime
 C = velocity of light
 σ = surface combination rate
 N = density of free carriers in the unilluminated specimen
 ℓ = thickness of specimen
 μ = electron mobility = hole mobility

The above formulas indicate that for high light values a "saturation" voltage is obtained equal to A.

These results fit both the published results of Kikoin and Noskov and also the recent measurements on germanium. Under certain limiting conditions, the different terms in the above formulas may be evaluated separately. By a combination of such experiments, it is possible to deduce all of the parameters characterizing the specimen under observation: the average carrier mobility, the diffusion coefficient, the lifetime of the carriers, and the surface recombination rate. Aigrain has suggested that this method may prove more convenient than conventional methods using the Hall effect and microelectrodes.

Notes describing these preliminary results will appear soon in Comptes Rendu, and further information will also be found in report ONRL-21-52 available from the Office of Naval Research, Technical Publications Office, Code 740, Washington 25, D.C.

MASS SPECTROGRAPH STABILIZATION APPARATUS

An interesting electronic apparatus has been developed by Dr. H. Lipkin, of the Weizmann Institute, Rehovoth, Israel, to provide a complete system of stabilization for a 180° mass spectrograph. It resembles in some ways the automatic frequency-control equipment used in radar receivers.

A small audio frequency voltage is superimposed on top of the accelerating voltage, V, for the ions (before they are deflected by the magnetic field). At the output slit this produces a corresponding oscillation in the position of the ion beam. The slit is broad enough so that there will be no change in output current if the ion beam center falls near the center of the slit. If, however, the instrument is "out of tune", a small audiofrequency component will appear in the output which can be amplified by means of a tuned audio amplifier. The output of the amplifier is fed into a phase-sensitive detector which operates a servomechanism controlling the magnitude of the accelerating voltage V. By varying V in the proper direction, the ion beam is returned to the center of the slit; in this way the mass spectrograph is locked on a peak in spite of small variations in its magnetic field and other factors.

In addition to this locking mechanism, Dr. Lipkin has introduced a slow scan mechanism which varies the voltage, V, over a pre-determined range, so that the mass spectrograph can search for the peak of the ion beam before the locking mechanism goes into operation.

This instrument has recently been put into operation and is being used for making automatic measurements of the $O^{18} : O^{16}$ ratio in connection with physical chemistry experiments at the Weizmann Institute.

THE RED SHIFT OF SOLAR SPECTRAL LINES

Dr. M.G. Adam of the Observatory, Oxford, has been engaged for the last five years on a study of the red shift of the solar spectral lines predicted by the theory of relativity. This shift is due to the strong gravitational field at the surface of the sun and should

be of the order of magnitude of 2×10^{-6} of the original wave length. Earlier experiments by Draper, St. John, and others have been inconclusive.

In the experiments of St. John (1928), red shifts of the order of 0.006A were found at wave lengths where the theory would predict 0.009A. The shift was found to vary between the center and the limb of the sun, and this was tentatively attributed to radial streaming of the emitting gases. One of the objects of the present research has been to explore this hypothesis by a series of measurements at different latitudes on the sun's disc.

On an elementary basis, the hypothesis of radial streaming would predict a shift varying as the cosine of the latitude. The shift actually found deviated distinctly from this relationship. It was substantially constant and of the order of 5×10^{-3}A for 0.9 of the radius of the sun and then rose rapidly at the limb to 13×10^{-3}A. As far as could be determined, this was compatible with the observations of Freundlich and Evershed. No explanation has been found for this characteristic.

Eddington and Mitra have pointed out that the hypothesis of radial streaming might lead to a variation with solar latitude different from the cosine function because of the differing depths with which one sees into the photosphere. An attempt was made to evaluate the parameters in the formulas of these authors, but with unsuccessful results.

The possibility was then considered that the shifts being observed were a mixture of those due to relativity and those due to a change in the energy levels of the radiating atoms because of the conditions of excitation, i.e. collisional shifts. This possibility is difficult to explore because of our ignorance of the excitation conditions in the photosphere of the sun, and our ignorance of the dependence of these shifts on excitation conditions. Accordingly, an effort was made to find a systematic dependence of the observed shift upon the energy levels involved and in particular to study a line in which the absorption took place from the ground state. This investigation was also unsuccessful. The chosen line (6572.8A Ca) was found to have a smaller rather than a larger shift than its immediate neighbors. No systematic dependence of the shift upon the energy of the lower state of the atom was found.

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Accordingly, the investigation must be described as unsuccessful to date, and the problem of the red shift of solar lines deserves further investigation. Such an investigation may have to be delayed until more information is available about collisional shifts.

INFRARED ABSORPTION SPECTRA AND CONFIGURATIONS OF SUB-
STITUTED CYCLOHEXANES

The infrared absorption spectra of a number of cyclohexane derivatives have recently been investigated by M. Larnaudie in the laboratories of Professor J. Lecomte (Paris). The results are in general agreement with expectations. The most surprising conclusion is that liquid cis-1,4-dichlorocyclohexane is probably a mixture of chair and boat configurations.

The presence of two isomers in monosubstituted cyclohexanes is due to the fact that there are two types of stereochemically different valences on each carbon atom: equatorial (e) and polar (p). The first spectroscopic observations of this phenomenon were made about twenty years ago by Kohlrausch. Larnaudie investigated the infrared absorption spectra of the following cyclohexane derivatives in the liquid and vapor phase: -D, $-CH_3$, -F, -Cl, -Br, and -I. Analysis of the spectra indicates that the equatorial isomer is the more stable one and the difference in stability appears to depend on the size of the substituent (cf. Comptes Rendu, 235, 154 (1952)).

The infrared absorption spectrum of trans-1,2-dihydroxycyclohexane corresponds to an equilibrium mixture of the 1p,2p and 1e,2e isomers. The 1e, 2e form is much the stabler one of these two. (cf. Comptes Rendu, 236, 909 (1953)).

A large number of absorption bands are observed in the region between 700 -1400 cm^{-1} in the spectra of trans-1,4-dichlorocyclohexane and the corresponding bromo derivative. The results can be satisfactorily explained on the basis of the predicted equilibrium between the 1p, 4p and 1e,4e forms. While Larnaudie's observations suggest that both forms persist in the solid state, it is possible that these were made on a supercooled liquid. In a similar study it was recently reported from Japan that in the crystalline state only the 1e,4e configuration persists (cf. JACS. 75, 166 (1953)).

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The observed spectrum of cis-1,4-dichlorocyclo-
hexane contains seven bands between 650 - 800 cm^{-1}, i.e.
considerably more than would be expected for a single
molecular configuration. Since the dynamic equilibrium
due to the flexible ring in this case corresponds to that
between 1e,4p $\rightleftharpoons$ 1p,4e it is not capable of providing

a new configuration. The results and also the similar ones
on the corresponding dibromo derivative are best explained
by assuming that there is a second configuration present
in which the cyclohexane ring has the boat form:
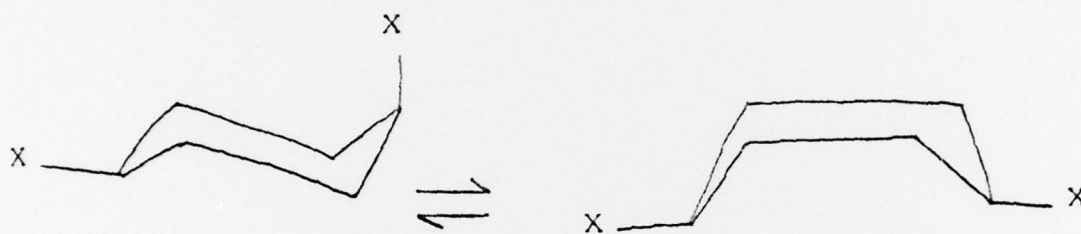
THE APPLICATION OF ULTRASONIC TECHNIQUES TO THE STUDY OF ROTATIONAL ISOMERISM

The application of ultrasonic techniques to the
study of rotational isomerism, especially in cyclohexane
derivatives, has been investigated by J. Karpovich work-
ing in Professor Willis Jackson's laboratory (Department
of Electrical Engineering, Imperial College, London). As
is well known, in normal liquids a plot of α/f^2 against
f gives a straight line. Here α is the acoustic absorption
coefficient and f is the frequency. An anomalous curve
consisting of a horizonatal straight line passing through
a sharp drop and ending in a new horizontal line at higher
frequencies has previously been reported for a number of
substances, such as carbon disulfide, a few acids and esters.
This is generally interpreted as a relaxation phenomenon,
corresponding to the disturbance in the state of a dynamic
equilibrium by the acoustic waves. Apparently the equili-
bria in question can be of several types, one of them
being that between rotational isomers, and thus the method
presents a valuable new tool in the study of this phenomenon.

Karpovich examined the ultrasonic absorption of a wide variety of organic liquids in the frequency range 20 kilocycles - 100 megacycles. From the stereochemical viewpoint the most interesting and consistent results are those obtained on the cyclohexane derivatives. These agree extremely well with expectations based on the chair form of the molecule and on the conclusions of previous investigators, especially Pitzer et al, on substituted cyclohexanes. The anomaly observed for cyclohexane confirms the pseudo chair and pseudo boat forms postulated by Pitzer.

The anomalous absorption of the simple organic acids was previously interpreted in terms of the monomer-dimer equilibrium. However, the energy required in the acid dimerization process is probably too high to be observable by acoustic techniques and rotational isomerism may provide a preferable explanation. The fact that the acoustic results obtained on the esters (which cannot form hydrogen bonded dimers) are very similar to those obtained on the acids supports this view. The two unexpected strong bands at 1160 and 1185cm^{-1} reported by Thompson and Torkington in the infrared spectra of a large series of organic esters are interpreted by Karpovich as belonging to rotational isomers. Dr. W.C. Price (Kings College, London) has recently observed that one of these bands of ethyl formate disappears on cooling.

The method used in these investigations is a resonance reverberation technique. Two crystals are suitably attached to the spherical container and the time constant of the decay of the radial mode excited by one crystal is observed by means of the other crystal. This time constant is related to the absorption of the acoustic waves in the medium.

Additional details are discussed in Technical Report ONRL-33-53 available from the Technical Publications Office, Code 740, Office of Naval Research, Department of the Navy, Washington 25, D.C.

MECHANICAL HYSTERESIS IN POLYCRYSTALLINE URANIUM

W. Munro and E.R.W. Jones (A.E.R.E., Harwell) have observed "elastic hysteresis" in specimens of wrought uranium of 99.95 per cent purity. The stress-strain line was found to be curved from the origin, as has previously been observed by other investigators; however, Munro and Jones have also found that the loading and unloading line

for a complete cycle forms a loop. This loop is similar
to the "elastic hysteresis" loops found in other metals
when they are stressed beyond their primitive elastic
limits.

The wrought uranium specimen was subjected
to 300 cycles of compressional stress at a maximum of 70,000
psi. The energy dissipated per stress cycle varied from
17.6×10^5 ergs/cc after ten cycles, to 12.4×10^5 ergs/cc
after 50 cycles, and further cycling did not decrease the
energy dissipation appreciably. This large energy dissipa-
tion is a factor of ten larger than that found in steel
or brass. The Poisson's ratio for uranium varies through-
out the stress cycle between the values of 0.22 and 0.29;
at the maximum stress point it was 0.26. For lower maximum
stresses, the Poisson's ratio showed even wider variation.

Munro and Jones explain "elastic hysteresis" in
polycrystalline samples in the following way. At first
the deformation in response to the load is elastic; i.e.
all grains deform uniformly. Then one of the grains yields
plastically, thus increasing the stress in the neighboring
grains, so that they in turn yield as the load is further
increased. Therefore the total strain is partly elastic
and partly plastic, and a curved stress-strain line is ob-
tained. A similar argument applies to the unloading part
of the cycle. The large dissipation of energy per cycle
in uranium (compared to steel and brass) suggests a dif-
ference in the mode of plastic deformation for this metal
from that of the usual structural metals. R.W. Cahn
(University of Birmingham) has recently demonstrated that
at low temperatures uranium deforms principally by twinning;
on the other hand steel and brass deform mostly by slip.
Applying this result to the above description of "elastic
hysteresis", Munro and Jones assume that twinning occurs
when the grains yield as the load is applied, and that
detwinning occurs as the load is removed.

Measurements have also been made on cast uranium,
and it was found that the energy loss per stress cycle is
larger than in wrought uranium.

THE USE OF PROTEIN SOLUTIONS FOR THE REFRACTOMETRY OF LIVING CELLS

Dr. R. Barer of the Department of Human Anatomy,
Oxford, has been developing techniques for the measurement
of the refractive index, the protein concentration, and the
total protein in living cells. He has recently found that

these studies are greatly facilitated by the use of a
series of water solutions of bovine plasma albumin. The
albumin is cheap, stable, harmless to the cells, and
highly soluble in water. With the aid of phase contrast
or interference microscopy, it is easy to judge whether
a particular cell has an index of refraction greater or
less than that of the immersion fluid. A series of ob-
servations with fluids of different concentrations thus
serve to determine the index of refraction of the cell.
To the extent that the "refractive increment" for protein
cell constituents is the same, i.e. about 0.0018 change
in index of refraction for 1 per cent change in concen-
tration, this measurement may be said to yield the con-
centration of protein in the cell directly.

Dr. Barer is now studying the application of
this technique to a series of problems, for instance, he
is determining the changes in protein concentration in
human blood cells in pathological conditions.

One potentially important use for this tech-
nique is in distinguishing live from dead cells. This
distinction is based on the increased permeability of
the cell wall which takes place after the death of the
cell. A suspension of cells in a medium of higher index
of refraction shows a distinct difference in brightness
between the live and dead cells when observed under phase
contrast. Apparently the dead cells quickly take in
additional protein to match the concentration of the
medium. This might be valuable in the study of blood
handling procedures and transfusion techniques.

Another use for this suspension medium is in
spectrophotometry. If the index of refraction of the
medium is matched to that of the cells, light scattering
can be tremendously reduced and the spectrum much more
easily and clearly determined.

ERRATUM: THE EFFECTS OF DAILY IRRADIATION BY FAST NEUTRONS

The dose rates given in the ESN item of this
title (ESN 7, 48 (1953)) should be stated in terms of "rep
per week" instead of "rep per day".

PERSONAL NEWS ITEMS

The following people from Great Britain have
indicated their firm intention of attending the International
Physiological Congress in Montreal, Canada, to be held on
August 31 to September 4, 1953:

Dr. B.C. Abbott

Miss P. Alexander

Dr. N. Ambache

Miss D. Armstrong

Prof. H. Barcroft

Dr. A.B.L. Beznak

Dr. H. Blaschko

Prof. J.H. Burn

Prof. G.A.H. Buttle

Dr. F.W. Campbell

Dr. M. Chance

Dr. M.H.D. Chennals

Dr. D.E. Cooper

Prof. E.W.H. Cruickshank

Dr. G.S. Dawes

Mr. E.J. Denton

Dr. M.H. Draper

Dr. O.G. Edholm

Dr. M. Grace Eggleton

Dr. G. Fegler

Dr. W. Feldberg

Dr. J.D. Ferguson

Dr. W.F. Floyd

Prof. J.H. Gaddum

Prof. E.M. Glaser

Prof. A.D.M. Greenfield

Dr. J.H. Green

Prof. R.A. Gregory

Dr. H. Herxheimer

Prof. A.St.G. Huggett

Prof. C.A. Keele

Miss L.M. Kerly

Prof. E.M. Killick

Dr. H.W. Kosterlitz

Dr. M.E. Langham

Dr. H. McIlwain

Dr. H.E. Magee

Miss J.C. Mott

Dr. Laurence Mount

Dr. W.D.M. Paton

Dr. R.J. Pennington

Dr. W.L.M. Perry

Dr. L.M. Pickford

Dr. M.H. Pirenne

Dr. J.M. Ritchie

Dr. J.T. Shepherd

Dr. A.U. Smith

Dr. R.P. Stephenson

Dr. D.W. Taylor

Dr. L.C. Thomson

Miss E.A. Ullmann

Dr. J.S. Weiner

Dr. Colin White

Dr. W.F. Widdas

Miss I.M. Young

Dr. E.J. Zaimis

Dr. I.C. Whitfield

D.J. Anderson

Dr. Michael Fry

Mr. George Darlow

Dr. Helen Duke

Dr. J.L. Mongar

Dr. H. Sosnowick

D.R. Wilkie

Dr. J.M. Walker

Dr. H. Wilson

Further information about positions and scientific interests
of these people can be obtained from the Office of Naval
Research, Code 439, Washington 25, D.C.

        Professor Jannik Bjerrum of the Technical
University of Denmark, Copenhagen, is planning a Conference
immediately following the Stockholm Meeting of the Inter-
national Union of Pure and Applied Chemistry. The discus-
sions at this Conference will be devoted largely to com-
plex compounds of metallic ions with organic and inorganic
ions and molecules. The Conference has been tentatively
scheduled for 9 - 12 August 1953.

Tentative plans have been made for holding
an International Symposium on Basic Aspects of Radiation
Damage to Living Cells, on July 16 - 18, in Copenhagen.
Thus the meeting would immediately precede the International
Radiological Congress. Further details in the planning of
this meeting are to be arranged by a committee, which in-
cludes Dr. A. Hollaender, Oak Ridge National Laboratory,
for the U.S.A.

FORTHCOMING EVENTS

        The following list of forthcoming events in
Europe for 1953 is compiled as supplementary information
to the preceding list (ESN 7, 27 (1953)).

Date	Meeting	Place
28 April - 1 May	International Health Congress	Hastings, England
18 - 23 May	Third International Congress d'Electrothermie	Paris
10-14 June	First Congress Societas Ophthalmologica Latina	Rome
18 - 29 June	26th International Congress of Industrial Chemistry	Paris
18 - 29 June	First International Congress on Corrosion	Paris
22 June - 4 July	International Electrotechnical Commission	Opatija, Yugoslavia
24 - 26 July	16th Congress Organization for the Avancement of Spectro-graphic Methods	Paris
23 - 27 July	International Astronomical Union - Symposium on the Co-ordination of Galactic Research	Groningen, Holland
13 - 14 July	The Physical Society, Papers on "Aspects of Spectroscopy, Acoustics and Theoretical Physics"	Newcastle-upon-Tyne

Date	Meeting	Place
13 - 18 July	Conference on Nuclear Physics	Birmingham
18 - 23 July	Conference on "Ionization Phenomena in Discharges"	Oxford
15 - 22 July	Summer School on Physical Chemistry of the Solid State	Bristol

Prepared by the Scientific Staff
Submitted by Dr. M.E. Bell
Scientific Director

for

PHILIP D. LOHMANN
Captain, U.S.N.
Assistant Naval Attache for Research